[4910-13-P]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. FAA-2021-0306; Project Identifier MCAI-2020-01493-E; Amendment 39-21706; AD 2021-18-05]

RIN 2120-AA64

Airworthiness Directives; Rolls-Royce Deutschland Ltd & Co KG (Type Certificate previously held by Rolls-Royce plc) Turbofan Engines

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: The FAA is superseding Airworthiness Directive (AD) 2020-15-12 for certain Rolls-Royce Deutschland Ltd & Co KG (RRD) Trent 1000 model turbofan engines. AD 2020-15-12 required initial and repetitive ultrasonic or visual inspections of the intermediate-pressure compressor (IPC) stage 1 rotor blade root (front face), IPC stage 2 rotor blade root (front and rear face), and IPC shaft stage 2 dovetail post (front face), and removal of any cracked parts from service. AD 2020-15-12 also required an inspection after asymmetric power and cabin depressurization events. This AD was prompted by IPC rotor blade separations resulting in engine failures. This AD requires initial and repetitive ultrasonic or visual inspections of certain IPC stage 1 rotor blade root, IPC stage 2 rotor blade root, and IPC shaft stage 2 dovetail posts until replacement of the IPC stage 1 and stage 2 rotor blades with redesigned IPC stage 1 and stage 2 rotor blades in kitted sets. The FAA is issuing this AD to address the unsafe condition on these products.

DATES: This AD is effective [INSERT DATE 35 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

The Director of the Federal Register approved the incorporation by reference of certain publications listed in this AD as of [INSERT DATE 35 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: For service information identified in this final rule, contact Rolls-Royce

plc, Corporate Communications, P.O. Box 31, Derby, DE24 8BJ, United Kingdom; phone: +44 (0)1332 242424; fax: +44 (0)1332 249936; website: https://www.rolls-royce.com/contact-us.aspx. You may view this service information at the FAA, Airworthiness Products Section, Operational Safety Branch, 1200 District Avenue, Burlington, MA 01803. For information on the availability of this material at the FAA, call (781) 238-7759. It is also available at https://www.regulations.gov by searching for and locating Docket No. FAA-2021-0306.

Examining the AD Docket

You may examine the AD docket at https://www.regulations.gov by searching for and locating Docket No. FAA-2021-0306; or in person at Docket Operations between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this final rule, any comments received, and other information. The address for Docket Operations is U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE, Washington, DC 20590.

FOR FURTHER INFORMATION CONTACT: Kevin Clark, Aviation Safety Engineer, ECO Branch, FAA, 1200 District Avenue, Burlington, MA 01803; phone: (781) 238-7088; fax: (781) 238-7199; email: kevin.m.clark@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

The FAA issued a notice of proposed rulemaking (NPRM) to amend 14 CFR part 39 to supersede AD 2020-15-12, Amendment 39-21175 (85 FR 45081, July 27, 2020), (AD 2020-15-12). AD 2020-15-12 applied to certain RRD Trent 1000-A2, Trent 1000-AE2, Trent 1000-C2, Trent 1000-CE2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, and Trent 1000-L2 model turbofan engines. The NPRM published in the *Federal Register* on April 22, 2021 (86 FR 21233). The NPRM was prompted by IPC rotor blade separations resulting in engine failures. Subsequently, the manufacturer identified the need to add new inspections and an optional terminating action, amend the asymmetric power condition for engine inspection, and to add an inspection after a cabin depressurization event. In the NPRM,

the FAA proposed to continue to require initial and repetitive ultrasonic or visual inspection of the IPC stage 1 rotor blade root (front face), IPC stage 2 rotor blade root (front and rear face), and IPC shaft stage 2 dovetail post (front face), removal of any cracked parts from service, and an inspection after asymmetric power and cabin depressurization events until the installation of the IPC stage 1 and stage 2 rotor blades with the IPC stage 1 and stage 2 rotor blades in kitted sets. The FAA is issuing this AD to address the unsafe condition on these products.

The European Union Aviation Safety Agency (EASA), which is the Technical Agent for the Member States of the European Community, has issued EASA AD 2020-0240, dated November 5, 2020 (referred to after this as "the MCAI"), to address the unsafe condition on these products. The MCAI states:

> Occurrences were reported on Rolls-Royce Trent 1000 'Pack C' engines, where some IPC Rotor 1 and Rotor 2 blades were found cracked.
>
> This condition, if not detected and corrected, could lead to in-flight blade release, possibly resulting in reduced control of the aeroplane.
>
> To address this potential unsafe condition, Rolls-Royce initially issued Alert NMSB TRENT 1000 72-AJ814 and 72-AJ819 to provide inspection instructions for IPC Rotor 1 blades, and IPC Rotor 2 blades and IPC shaft Stage 2 dovetail posts, respectively. Rolls-Royce also issued NMSB TRENT 1000 72-J871 to provide rework instructions for the affected parts, and Alert NMSB TRENT 1000 72-AJ869 to inspect those post-rework parts. Consequently, EASA issued AD 2017-0248 to require repetitive inspections of the affected IPC Rotor blades and IPC shaft Stage 2 dovetail posts and, depending on findings, removal from service of the engine for corrective action.
>
> After that [EASA] AD was issued, Rolls-Royce issued Alert NMSB TRENT 1000 72-AK058 to provide instructions for a one-

time on-wing inspection. Consequently, EASA issued AD 2018-0073, retaining the requirements of EASA AD 2017-0248, which was superseded, to require an additional borescope inspection of certain engines and, depending on findings, removal from service of the engine for corrective action.

After that [EASA] AD was issued, it was determined that repetitive borescope inspections are necessary on all engines to ensure fleet-wide continued safe operation. Consequently, Rolls-Royce revised Alert NMSB TRENT 1000 72-AJ869, Alert NMSB TRENT 1000 72-AJ814, Alert NMSB TRENT 1000 72-AJ819 and NMSB TRENT 1000 72-J871, and issued NMSB TRENT 1000 72-AK060 to consolidate all inspection instructions. Consequently, EASA issued AD 2018-0084 (later revised), retaining the requirements of EASA AD 2018-0073, which was superseded, and requiring repetitive on-wing borescope inspections of the affected Rotor 1 parts and affected Rotor 2 parts and, depending on findings, removal from service of the engine for corrective action. That [EASA] AD also introduced specific requirements for engines installed on aeroplanes involved in ETOPS, and inspection following operation in asymmetric power conditions.

Rolls-Royce then introduced NMSB Trent 1000 72-AK092 to provide inspections for the rear face of the Rotor 2 blades and NMSB TRENT 1000 72-AK060 was revised (R1) accordingly. Later, Rolls-Royce developed mod 72-J941, installing improved IPC Stage 1 and Stage 2 rotor blades, and issued the modification SB, providing the necessary instructions for in-service application. EASA issued AD 2018-0084R2 to exclude post-mod 72-J941 engines from the Applicability and introducing the modification SB as terminating action for the repetitive inspections as required by that [EASA] AD.

> After that [EASA] AD was issued, Rolls-Royce issued NMSB TRENT 1000 72-AK313 and revised Alert NMSB TRENT 1000 72-AJ814, 72-AJ819 and 72-AK092 to introduce new inspections, new thresholds and new intervals, depending on engine configuration. These inspections are for all operations, ETOPS and non-ETOPS. The latest revision of the NMSB also amended the asymmetric power conditions for engine inspection and introduced cabin depressurisation as an event to trigger engine inspection(s). Consequently, EASA issued AD 2019-0250 to require introduction of the new inspections, replacing those previously imposed by EASA AD 2018-0084R2 (through NMSB TRENT 1000 72-AK060), and to remove the references to Engine Health Monitoring messages and ETOPS-related requirements.
>
> Since that [EASA] AD was issued, it was discovered that the manufacturing distribution of the individual blade frequencies could differ from the assumed values during certification of the SB TRENT 1000 72-J941, which means there may not be sufficient margin to prevent the blades from experiencing high vibration levels. Prompted by these findings, Rolls-Royce issued the modification SB to provide blade kitting instructions.

You may obtain further information by examining the MCAI in the AD docket at https://www.regulations.gov by searching for and locating Docket No. FAA-2021-0306.

Discussion of Final Airworthiness Directive

Comments

The FAA received comments from 1 commenter. The commenter was The Boeing Company (Boeing). Boeing supported the NPRM without change.

Conclusion

The FAA reviewed the relevant data, considered the comment received, and determined that air safety requires adopting the AD as proposed. Accordingly, the FAA is

issuing this AD to address the unsafe condition on these products. Except for minor editorial changes, this AD is adopted as proposed in the NPRM.

Related Service Information under 1 CFR Part 51

The FAA reviewed Rolls-Royce Alert Non-Modification Service Bulletin (NMSB) Trent 1000 72-AK313, Revision 1, dated August 22, 2019; and Rolls-Royce Alert Service Bulletin (SB) Trent 1000 72-AK430, Initial Issue, dated August 17, 2020. Rolls-Royce Alert NMSB Trent 1000 72-AK313 defines the initial inspection threshold and repeat inspection intervals for Trent 1000 IPC stage 1 rotor blade, IPC stage 2 rotor blade, and IPC shaft stage 2 dovetail posts. Rolls-Royce Alert SB Trent 1000 72-AK430 introduces the IPC stage 1 and stage 2 rotor blades in kitted sets and provides kitting instructions. This service information is reasonably available because the interested parties have access to it through their normal course of business or by the means identified in ADDRESSES.

Other Related Service Information

The FAA reviewed Rolls-Royce Alert NMSB Trent 1000 72-AJ814, Revision 5, dated May 3, 2019; Rolls-Royce Alert NMSB Trent 1000 72-AJ819, Revision 4, dated May 3, 2019; Rolls-Royce Alert NMSB Trent 1000 72-AK092, Revision 4, dated May 3, 2019; Rolls-Royce SB Trent 1000 72-J871, Revision 6, dated December 12, 2019; and Rolls-Royce SB Trent 1000 72-J941, Revision 1, dated February 6, 2019.

Rolls-Royce Alert NMSB Trent 1000 72-AJ814 describes procedures for performing an ultrasonic inspection (USI) of the IPC stage 1 rotor blades. Rolls-Royce Alert NMSB Trent 1000 72-AJ819 describes procedures for performing a visual borescope inspection of the IPC stage 2 rotor blades and IPC shaft stage 2 dovetail posts. Rolls-Royce Alert NMSB Trent 1000 72-AK092 describes procedures for performing a USI of the IPC stage 2 rotor blades. Rolls-Royce SB Trent 1000 72-J871 describes procedures for reworking or replacing the affected parts. Rolls-Royce SB Trent 1000 72-J941 specifies procedures for installing the redesigned IPC stage 1 and stage 2 rotor blades.

Costs of Compliance

The FAA estimates that this AD affects 7 engines installed on airplanes of U.S. registry.

The FAA estimates the following costs to comply with this AD:

Estimated costs

Action	Labor Cost	Parts Cost	Cost per product	Cost on U.S. operators
Inspect the IPC stage 1 rotor blade root (Front Face)	20 work-hours x $85 per hour = $1,700	$0	$1,700	$11,900
Inspect the IPC stage 2 rotor blade root (Front Face) and IPC shaft stage 2 dovetail post (Front Face)	6 work-hours x $85 per hour = $510	$0	$510	$3,570
Inspect the IPC stage 2 rotor blade root (Rear Face)	10 work-hours x $85 per hour = $850	$0	$850	$5,950
Replace all 34 IPC stage 1 rotor blades (mandatory terminating action)	280 work-hours x $85 per hour = $23,800	$52,360	$76,160	$533,120
Replace all 49 IPC stage 2 rotor blades (mandatory terminating action)	280 work-hours x $85 per hour = $23,800	$48,755	$72,555	$507,885

The FAA estimates the following costs to do any necessary replacements that would be required based on the results of the inspection. The agency has no way of determining the number of aircraft that might need these replacements:

On-condition costs

Action	Labor Cost	Parts Cost	Cost per Product
Replace all 34 IPC stage 1 rotor blades	280 work-hours x $85 per hour = $23,800	$52,360	$76,160

Replace all 49 IPC stage 2 rotor blades	280 work-hours x $85 per hour = $23,800	$48,755	$72,555
Replace the IPC drum assembly	144 work-hours x $85 per hour = $12,240	$1,370,000	$1,382,240

Authority for this Rulemaking

Title 49 of the United States Code specifies the FAA's authority to issue rules on aviation safety. Subtitle I, Section 106, describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the Agency's authority.

The FAA is issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701: General requirements. Under that section, Congress charges the FAA with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it addresses an unsafe condition that is likely to exist or develop on products identified in this rulemaking action.

Regulatory Findings

The FAA has determined that this AD will not have federalism implications under Executive Order 13132. This AD will not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.

For the reasons discussed above, I certify that this AD:

(1) Is not a "significant regulatory action" under Executive Order 12866,

(2) Will not affect intrastate aviation in Alaska, and

(3) Will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

List of Subjects in 14 CFR Part 39

Air transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

The Amendment

Accordingly, under the authority delegated to me by the Administrator, the FAA amends 14 CFR part 39 as follows:

PART 39 - AIRWORTHINESS DIRECTIVES

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

§ 39.13 [Amended]

2. The FAA amends § 39.13 by:

a. Removing Airworthiness Directive AD 2020-15-12, Amendment 39-21175 (85 FR 45081, July 27, 2020); and

b. Adding the following new airworthiness directive:

2021-18-05 Rolls-Royce Deutschland Ltd & Co KG (Type Certificate previously held by Rolls-Royce plc): Amendment 39-21706; Docket No. FAA-2021-0306; Project Identifier MCAI-2020-01493-E.

(a) Effective Date

This airworthiness directive (AD) is effective [INSERT DATE 35 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

(b) Affected ADs

This AD replaces AD 2020-15-12, Amendment 39-21175 (85 FR 45081, July 27, 2020).

(c) Applicability

This AD applies to Rolls-Royce Deutschland Ltd & Co KG (Type Certificate previously held by Rolls-Royce plc) Trent 1000-A2, Trent 1000-AE2, Trent 1000-C2, Trent 1000-CE2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, and Trent 1000-L2 model turbofan engines, except those that have the redesigned intermediate-pressure compressor (IPC) stage 1 and stage 2 rotor blades introduced by Rolls-Royce (RR) Service Bulletin (SB) Trent 1000 72-J941, Initial Issue, dated December 6, 2016, or Revision 1, dated February 6, 2019.

(d) Subject

Joint Aircraft System Component (JASC) Code 7230, Turbine Engine Compressor Section.

(e) Unsafe Condition

This AD was prompted by IPC rotor blade separations resulting in engine failures. The FAA is issuing this AD to prevent failure of the IPC. The unsafe condition, if not addressed, could result in failure of one or more engines, loss of thrust control, and loss of the airplane.

(f) Compliance

Comply with this AD within the compliance times specified, unless already done.

(g) Required Actions

(1) After the effective date of this AD, before exceeding the initial inspection thresholds and repeat inspection intervals specified in Table 1 of RR Alert Non-Modification Service Bulletin (NMSB) Trent 1000 72-AK313, Revision 1, dated August 22, 2019 (RR NMSB Trent 1000 72-AK313 R1):

(i) Perform initial ultrasonic inspections (USIs) of the IPC stage 1 rotor blade root (front face).

(ii) Thereafter, perform repetitive USIs of the IPC stage 1 rotor blade root (front face).

(iii) Use the Accomplishment Instructions, paragraph 3.A.(1)(a) (on-wing) or 3.A.(2)(a) and (b) (in-shop), of RR NMSB Trent 1000 72-AK313 R1 to perform the inspections.

(2) After the effective date of this AD, before exceeding the initial inspection thresholds and repeat inspection intervals specified in Table 2 of RR NMSB Trent 1000 72-AK313 R1:

(i) Perform initial visual inspections of the IPC stage 2 rotor blade root (front face) and IPC shaft stage 2 dovetail post (front face).

(ii) Thereafter, perform repetitive visual inspections of the IPC stage 2 rotor blade root (front face) and IPC shaft stage 2 dovetail post (front face).

(iii) Use the Accomplishment Instructions, paragraph 3.B.(1)(a) (on-wing) or 3.B.(2)(b) (in-shop), of RR NMSB Trent 1000 72-AK313 R1 to perform the inspections.

(3) After the effective date of this AD, before exceeding the initial inspection threshold and repeat inspection intervals specified in Table 2 of RR NMSB Trent 1000 72-AK313 R1:

(i) Perform initial USIs of IPC stage 2 rotor blade root (rear face).

(ii) Thereafter, perform repetitive USIs of IPC stage 2 rotor blade root (rear face).

(iii) Use the Accomplishment Instructions, paragraph 3.C.(1)(a) (on-wing) or 3.C.(2)(a) (in-shop), of RR NMSB Trent 1000 72-AK313 R1 to perform the inspections.

(4) After the effective date of this AD, within 5 engine flight cycles (FCs) after each occurrence in which any engine operates in asymmetric power conditions at an altitude of less than 28,000 feet, perform the following inspections on the engine not affected by the power reduction or in-flight shutdown (IFSD):

(i) Perform initial USIs and visual inspections required by paragraphs (g)(1) through (3) of this AD.

(ii) Thereafter, perform the repetitive USIs and visual inspections required by paragraphs (g)(1) through (3) of this AD.

(iii) Use the service information and repetitive inspection thresholds required by paragraphs (g)(1)(iii), (2)(iii), and (3)(iii) to perform the inspections, as applicable.

(5) After the effective date of this AD, within 5 engine FCs following a cabin depressurization event, perform the following inspections on both engines installed on the airplane:

(i) Perform initial USIs and visual inspections required by paragraphs (g)(1) through (3) of this AD.

(ii) Thereafter, perform the repetitive USIs and visual inspections required by paragraphs (g)(1) through (3) of this AD.

(iii) Use the service information and repetitive inspection thresholds required by paragraphs (g)(1)(iii), (2)(iii), and (3)(iii) to perform the inspections, as applicable.

(6) If any IPC stage 1 rotor blade root (front face), IPC stage 2 rotor blade root (front face), or IPC stage 2 rotor blade root (rear face) is found cracked during any

inspection required by this AD, replace the part with a part eligible for installation before further flight.

(7) If any IPC shaft stage 2 dovetail post (front face) is found cracked during any inspection required by this AD, replace the IPC drum assembly.

(h) Mandatory Terminating Action

At the next engine shop visit after the effective date of this AD, replace the IPC stage 1 and stage 2 rotor blades with redesigned IPC stage 1 and stage 2 rotor blades introduced by RR SB Trent 1000 72-J941, Revision 1, dated February 6, 2019. Install the blades as kitted sets using the Accomplishment Instructions, paragraph 3.C. (In-Shop), of RR Alert SB Trent 1000 72-AK430, Initial Issue, dated August 17, 2020. This replacement of the IPC stage 1 and stage 2 rotor blades as kitted sets is a terminating action for the initial and repetitive ultrasonic or visual inspection requirements, as applicable, required by paragraphs (g)(1) through (5) of this AD.

(i) Definitions

(1) For the purpose of this AD, an "asymmetric power condition" is the operation of the airplane at an altitude of less than 28,000 feet, experiencing either single engine take-off, engine fault (reduced power on one engine), or single engine IFSD, which includes execution of any non-normal checklist procedure.

(2) For the purpose of this AD, an "engine shop visit" is the induction of an engine into the shop for maintenance involving the separation of pairs of major mating engine case flanges, except that the separation of engine flanges solely for the purposes of transportation without subsequent engine maintenance does not constitute an engine shop visit.

(j) Credit for Previous Actions

You may take credit for the initial inspections required by paragraphs (g)(1) through (5) of this AD if you performed these inspections before the effective date of this AD using any of the following.

(1) RR Alert NMSB Trent 1000 72-AJ819, Revision 3, dated April 13, 2018, or earlier revisions;

(2) RR Alert NMSB Trent 1000 72-AJ814, Revision 4, dated September 28, 2018, or earlier revisions;

(3) RR Alert NMSB Trent 1000 72-AK313, Initial Issue, dated May 2, 2019; or

(4) RR Alert NMSB Trent 1000 72-AK092, Revision 3, dated February 28, 2019, or earlier revisions.

(k) Special Flight Permit

A special flight permit may be issued in accordance with 14 CFR 21.197 and 21.199 to permit a one-time non-revenue ferry flight to a location where the engine can be removed from service for operators who are prohibited from further flight due to a crack finding as a result of paragraph (g) of this AD. This ferry flight must be performed without passengers, involve non-ETOPS operation, and consume no more than three FCs.

(l) Alternative Methods of Compliance (AMOCs)

(1) The Manager, ECO Branch, FAA, has the authority to approve AMOCs for this AD, if requested using the procedures found in 14 CFR 39.19. In accordance with 14 CFR 39.19, send your request to your principal inspector or local Flight Standards District Office, as appropriate. If sending information directly to the manager of the certification office, send it to the attention of the person identified in Related Information. You may email your request to: ANE-AD-AMOC@faa.gov.

(2) Before using any approved AMOC, notify your appropriate principal inspector, or lacking a principal inspector, the manager of the local flight standards district office/certificate holding district office.

(m) Related Information

(1) For more information about this AD, contact Kevin Clark, Aviation Safety Engineer, ECO Branch, FAA, 1200 District Avenue, Burlington, MA 01803; phone: (781) 238-7088; fax: (781) 238-7199; email: kevin.m.clark@faa.gov.

(2) Refer to European Union Aviation Safety Agency (EASA) AD 2020-0240, dated November 5, 2020, for more information. You may examine the EASA AD in the AD docket at https://www.regulations.gov by searching for and locating Docket No. FAA-2021-0306.

(n) Material Incorporated by Reference

(1) The Director of the Federal Register approved the incorporation by reference (IBR) of the service information listed in this paragraph under 5 U.S.C. 552(a) and 1 CFR part 51.

(2) You must use this service information as applicable to do the actions required by this AD, unless the AD specifies otherwise.

(i) Rolls-Royce Alert Non-Modification Service Bulletin Trent 1000 72-AK313, Revision 1, dated August 22, 2019.

(ii) Rolls-Royce Alert Service Bulletin Trent 1000 72-AK430, Initial Issue, dated August 17, 2020.

(3) For Rolls-Royce service information identified in this AD, contact Rolls-Royce plc, Corporate Communications, P.O. Box 31, Derby, DE24 8BJ, United Kingdom; phone: +44 (0)1332 242424; fax: +44 (0)1332 249936; website: https://www.rolls-royce.com/contact-us.aspx.

(4) You may view this service information at the FAA, Airworthiness Products Section, Operational Safety Branch, 1200 District Avenue, Burlington, MA 01803. For information on the availability of this material at the FAA, call (781) 238-7759.

(5) You may view this service information that is incorporated by reference at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, email: fr.inspection@nara.gov, or go to: https://www.archives.gov/federal-register/cfr/ibr-locations.html.

Issued on August 23, 2021.

Gaetano A. Sciortino, Deputy Director for Strategic Initiatives,
Compliance & Airworthiness Division,
Aircraft Certification Service.

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